

**What is claimed is:**

1. A compound semiconductor structure comprising:  
a GaAs-based supporting semiconductor structure;  
5 a first layer of gallium oxide located on a surface of the supporting semiconductor structure to form an interface therewith; and  
a second layer of a Ga-Gd oxide disposed on the first layer.
2. The compound semiconductor structure of claim 1 wherein the Ga-Gd  
10 oxide is  $\text{Gd}_3\text{Ga}_5\text{O}_{12}$ .
3. The compound semiconductor structure of claim 1 wherein the GaAs-based supporting semiconductor structure is a GaAs-based heterostructure.
- 15 4. The compound semiconductor structure of claim 3 wherein the GaAs-based supporting semiconductor structure is an at least partially completed metal-oxide field effect transistor.
- 20 5. The compound semiconductor structure of claim 3 wherein the GaAs-based supporting semiconductor structure is an at least partially completed heterojunction bipolar transistor.
- 25 6. The compound semiconductor structure of claim 3 wherein the GaAs-based supporting semiconductor structure is an at least partially completed semiconductor laser.
7. The compound semiconductor structure of claim 1 wherein the first layer of gallium-oxide has a thickness in a range of approximately .5 nm to 10 nm.

8. The compound semiconductor structure of claim 1 wherein the second layer of Ga-Gd oxide has a thickness in a range of approximately 5 nm to 20 nm.

9. A method of forming a dielectric layer structure on a supporting semiconductor structure comprising the steps of:  
providing a GaAs-based supporting semiconductor structure;  
depositing a first layer of gallium oxide on a surface of the supporting structure; and  
depositing a second layer of a Ga-Gd-oxide on the first layer.

10. The method of claim 9 wherein the step of depositing the layer of gallium oxide includes depositing the layer of gallium oxide by evaporation.

11. The method of claim 10 wherein the step of depositing a layer of gallium oxide on the surface of the supporting semiconductor structure by evaporation includes one of thermal evaporation, electron beam evaporation, and laser ablation.

12. The method of claim 11 further comprising the step of evaporating atomic oxygen during at least a portion of the step of depositing the layer of gallium oxide.

13. The method of claim 12 wherein the step of evaporating atomic oxygen begins after at least one monolayer of gallium oxide has been deposited onto the surface of the supporting semiconductor structure.

14. The method of claim 10 wherein the step of depositing the second layer includes the step of evaporating Gd.

15. The method of claim 13 wherein the step of depositing the second layer includes the step of evaporating Gd.

16. The method of claim 15 wherein the step of evaporating atomic oxygen commences before the step of evaporating Gd.

5 17. The method of claim 15 wherein the step of evaporating Gd commences before the step of evaporating atomic oxygen.

18. The method of claim 9 wherein the Ga-Gd oxide is  $\text{Gd}_3\text{Ga}_5\text{O}_{12}$ .

10 19. The method of claim 9 wherein the GaAs-based supporting semiconductor structure is a GaAs-based heterostructure.

15 20. The method of claim 19 wherein the GaAs-based supporting semiconductor structure is an at least partially completed metal-oxide field effect transistor.

21. The method of claim 19 wherein the GaAs-based supporting semiconductor structure is an at least partially completed heterojunction bipolar transistor.

20 22. The method of claim 19 wherein the GaAs-based supporting semiconductor structure is an at least partially completed semiconductor laser.

25 23. The method of claim 9 wherein the first layer of gallium oxide has a thickness in a range of approximately 0.5 nm to 10 nm.

24. The method of claim 9 wherein the second layer of Ga-Gd oxide has a thickness in a range of approximately 5 nm to 20 nm.